

Greater Sage-Grouse Lek Monitoring Along the Cedar Creek Anticline

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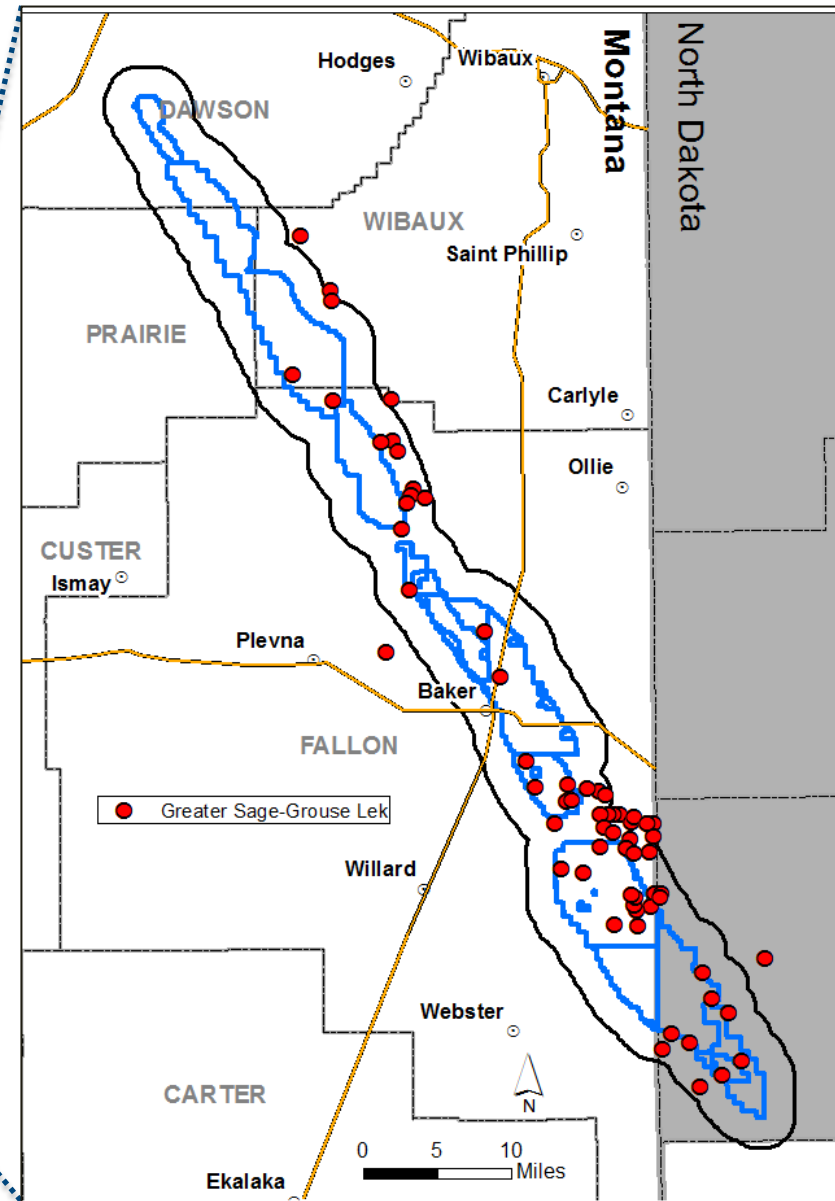
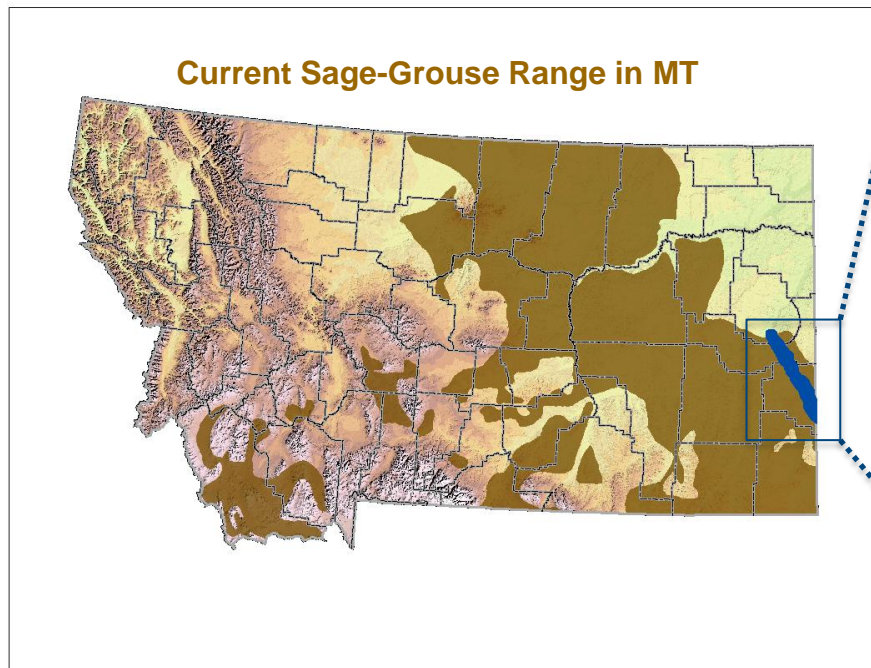
- Lek count surveys conducted 2007-2013
- Surveys funded by oil/gas companies, but were voluntary—not required by state or federal agencies
- Known sage-grouse lek locations were provided by MTFWP, BLM, and NDGFD
- Surveyed all known and unconfirmed leks within 2 miles of project area
- Project area determined by lease area or unit boundaries from funding companies
- Surveys funded by:
 - 2007-2008: Fidelity Exploration & Production
 - 2009-2011: Fidelity E&P and Encore (jointly)
 - 2012-2013: Denbury (acquired Encore)

- **Compliance and Monitoring**
 - Provide information on annual lek status
 - Document male lek attendance and annual changes
 - Ensure lek locations are up-to-date and accurate
 - Search for new or previously-undocumented leks

- Only data collected by HWA are included
 - 2007-2013 (7 years)
- Represents a preliminary non-statistical assessment of trends in sage-grouse male lek attendance and lek persistence
- Several important landscape features not considered for this presentation (i.e., vegetation, topography, wind farms, overhead power lines, roads, etc.)
- More comprehensive analyses are planned for the near future

Project Area: Cedar Creek Anticline

- Surveys limited to leks in Montana and a few along the border with North Dakota
 - Leks in North Dakota surveyed by NDGFD

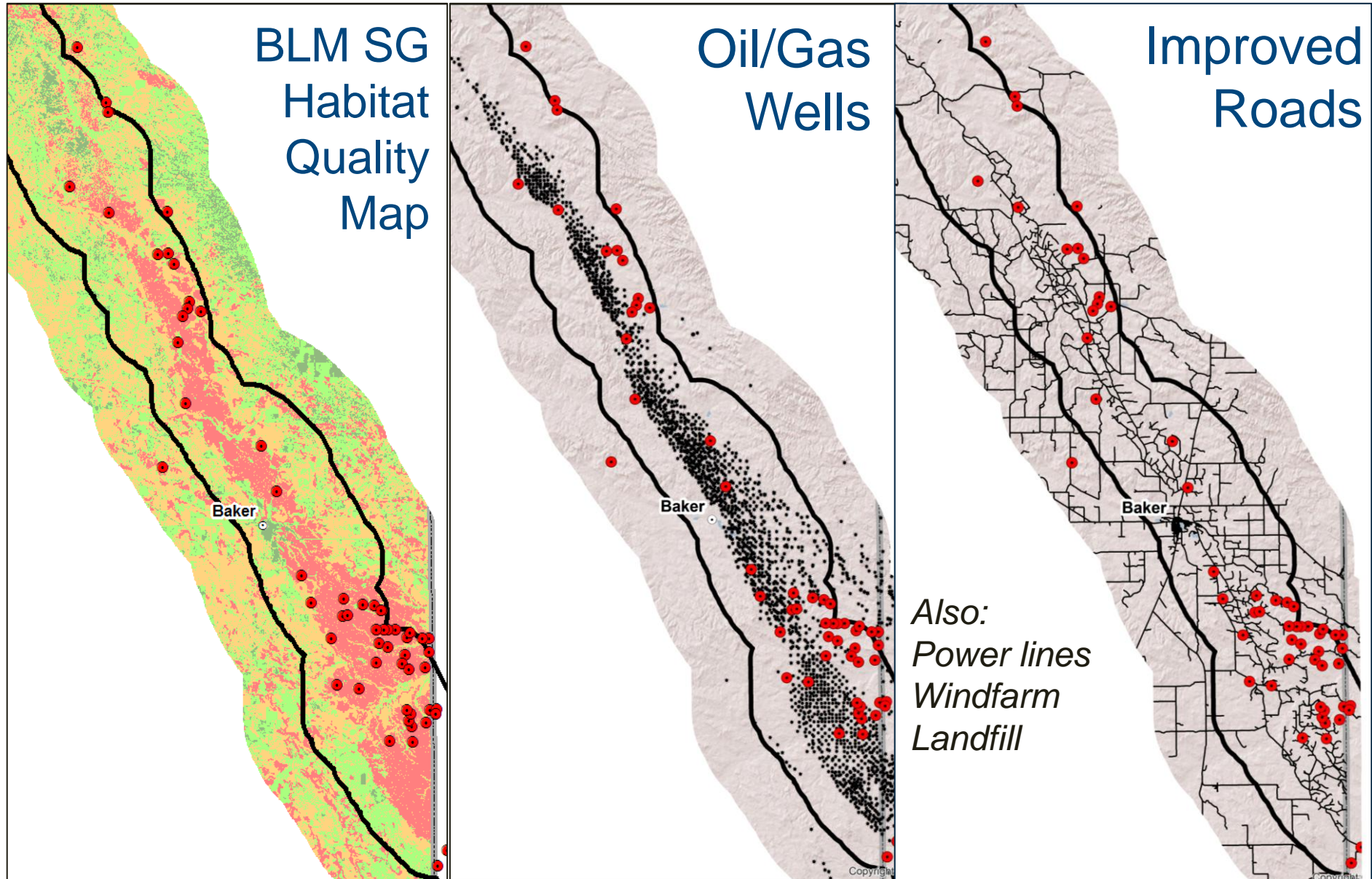


Example of Typical Lek Location

- Grassland-dominated landscape
 - low density sagebrush
 - eastern-most fringe of current range



Landscape Features of Project Area

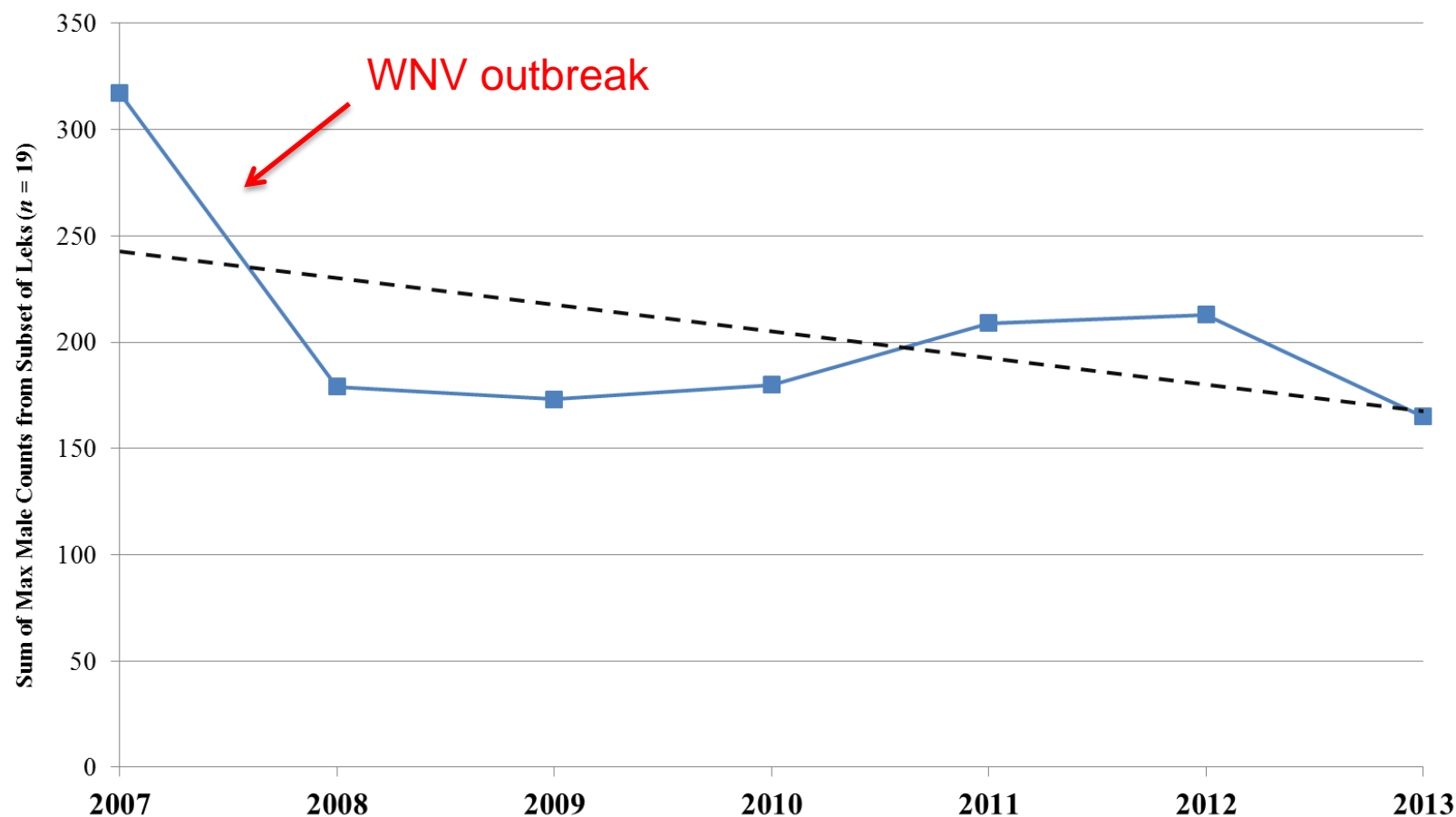


RESULTS: Sage-Grouse Lek Counts

Parameter	2007	2008	2009	2010	2011	2012	2013	Mean
Leks counted	37	38	42	44	44	44	44	42
Males/lek	8.92	5.18	5.29	5.14	5.57	6.00	4.55	5.81
Active leks	21	22	21	22	22	23	22	21.86
% active leks	57	58	50	50	50	52	50	52.42
Males/active lek	15.71	8.95	10.57	10.27	11.14	11.48	9.09	11.03
Population Growth Rate*	--	0.565	0.966	1.040	1.161	1.019	0.775	0.92

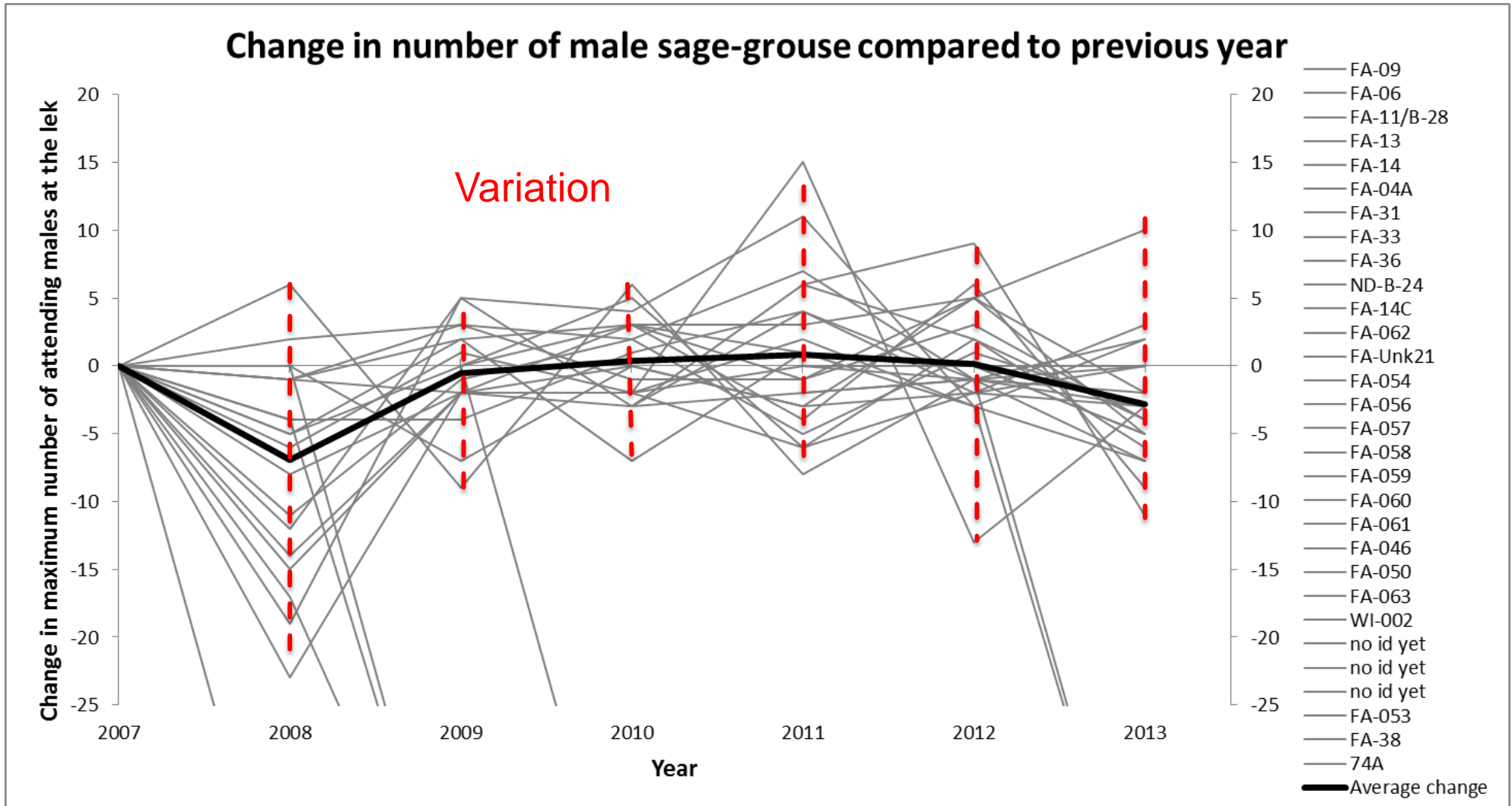
* Calculated using subset of leks ($n = 19$), all active in 2007 and surveyed annually since.

Sum of Max Male Counts



- Index based on subset of ($n = 19$) leks, all of which were active during the 1st year of monitoring and have been surveyed consistently each year since.

Trends: Collective Patterns and Variation

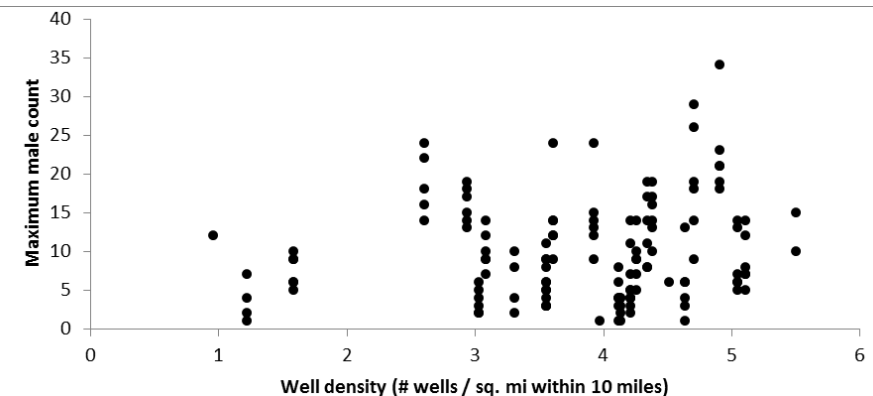
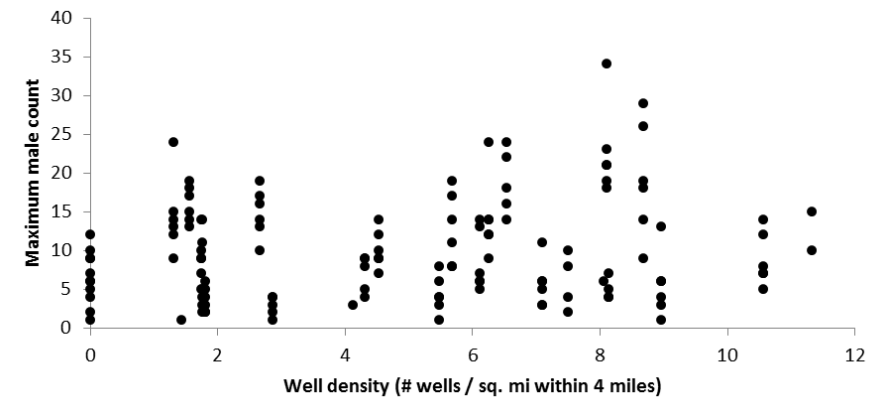
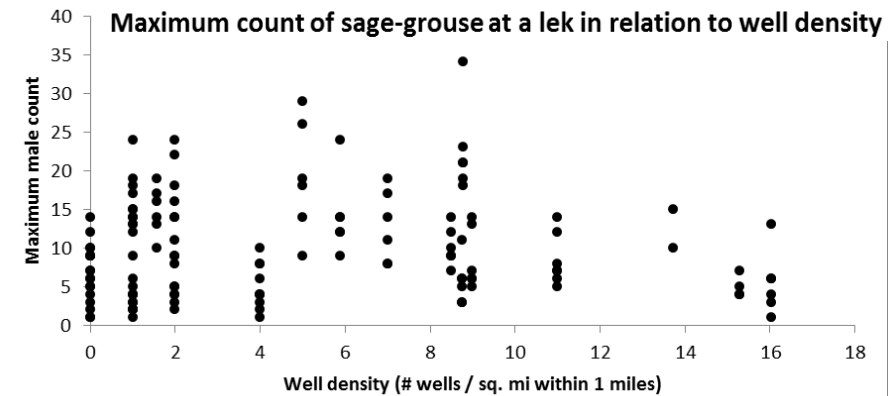
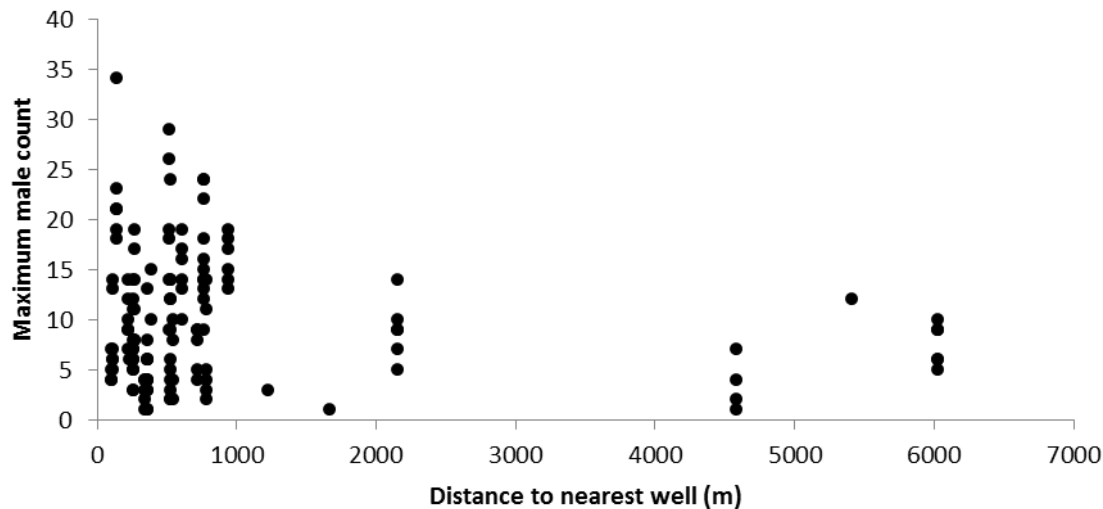


- All changes are relative to 2007 counts, so 2007 numbers are standardized to zero for comparative purposes

Abundance In Relation to Oil/Gas Wells

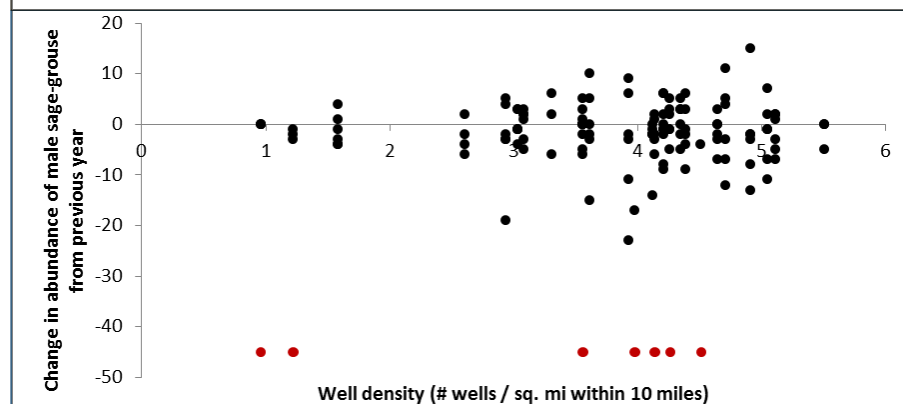
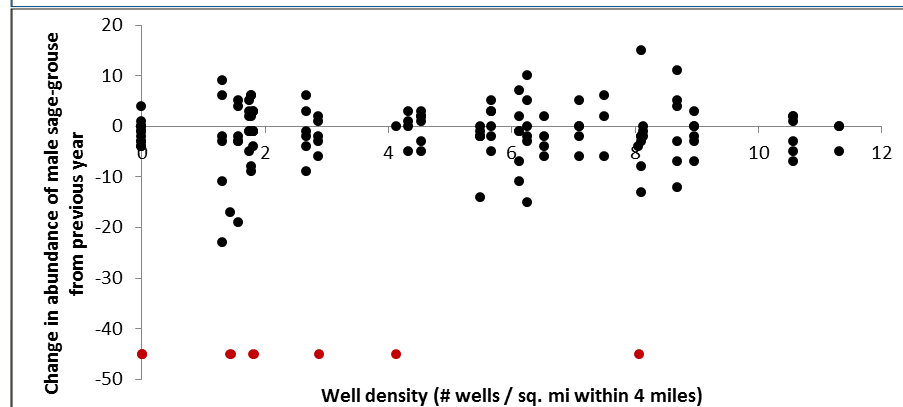
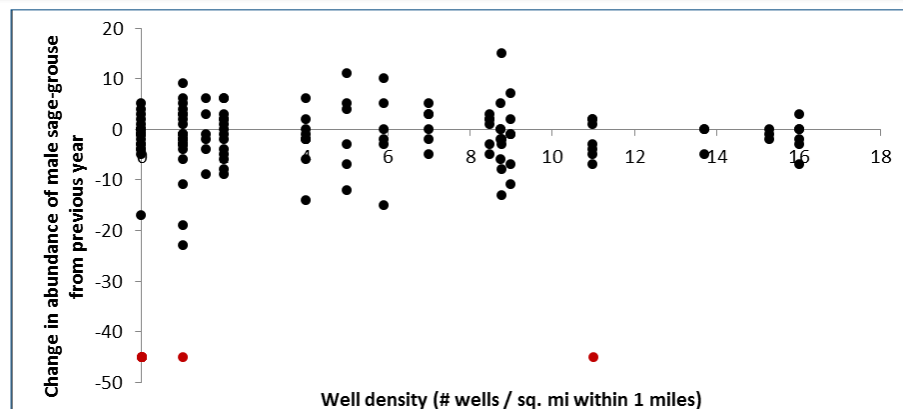
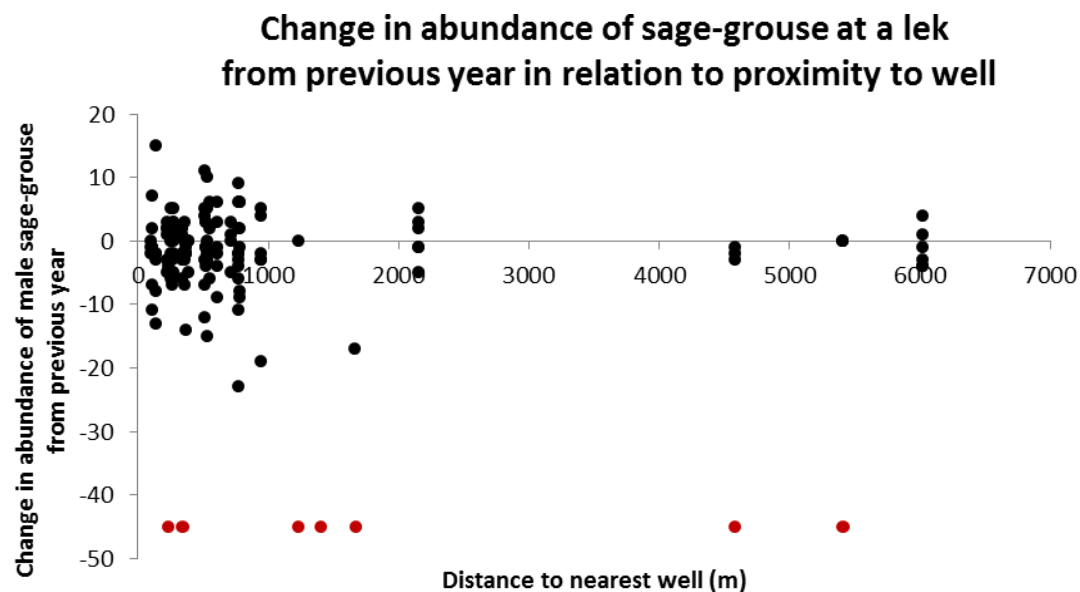
- Max male count relative to the proximity to and density of oil/gas wells
- Considered well data from 2006 (displayed below) and 2013
- Used scales of 1, 4, and 10 sq. miles for well density
 - **No apparent pattern regarding abundance in relation to oil/gas features at these scales**

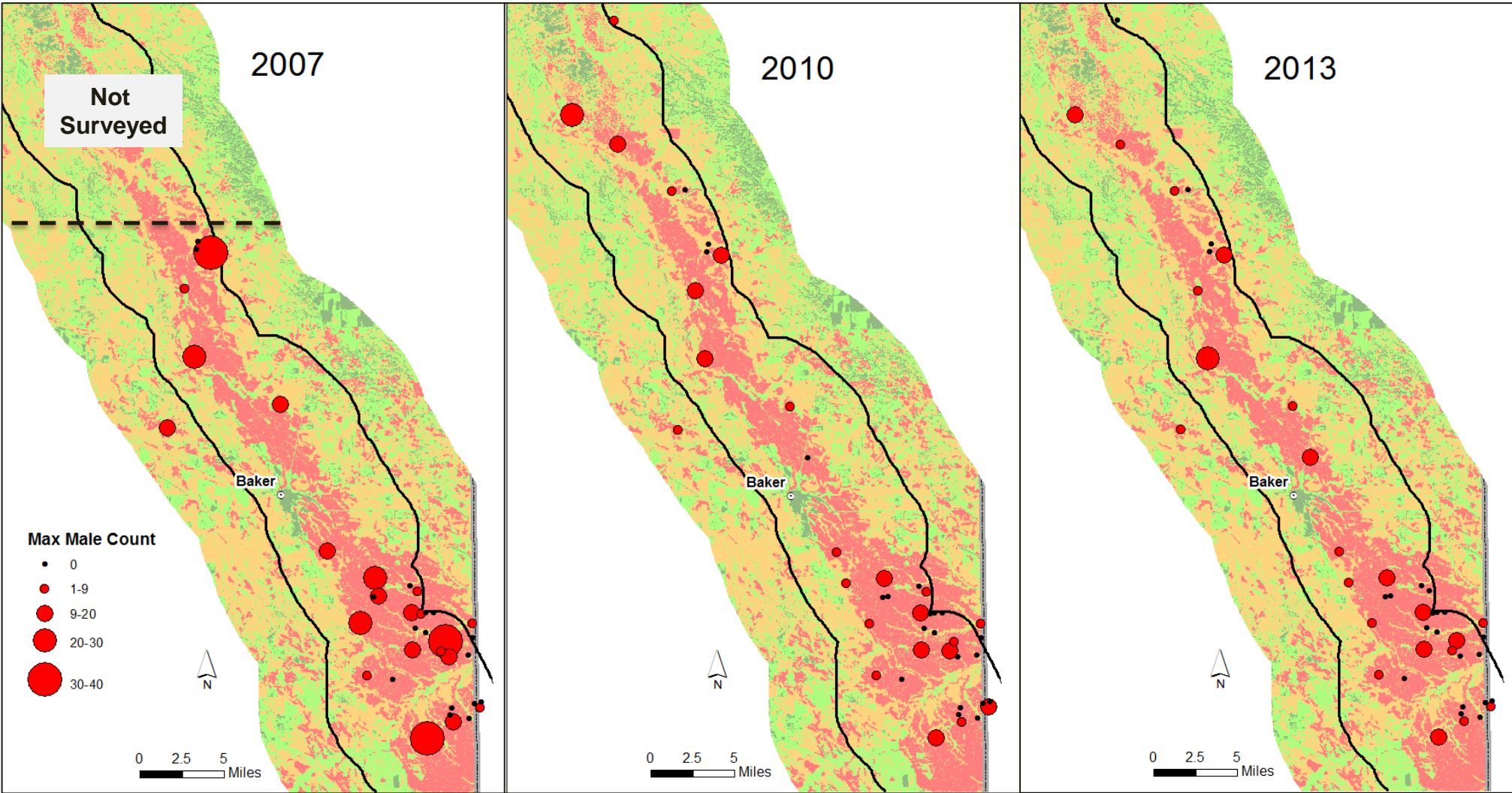
Maximum count of sage-grouse at a lek
in relation to distance to the nearest well



Change in Abundance in Relation to Oil/Gas Wells

- Change in abundance from the previous year relative to proximity to and density of oil/gas wells
- Considered well data from 2006 (displayed below) and 2013
- Used scales of 1, 4, and 10 sq. miles for well density
 - **No apparent relationship between change in abundance and proximity/density of oil/gas features, at these scales**

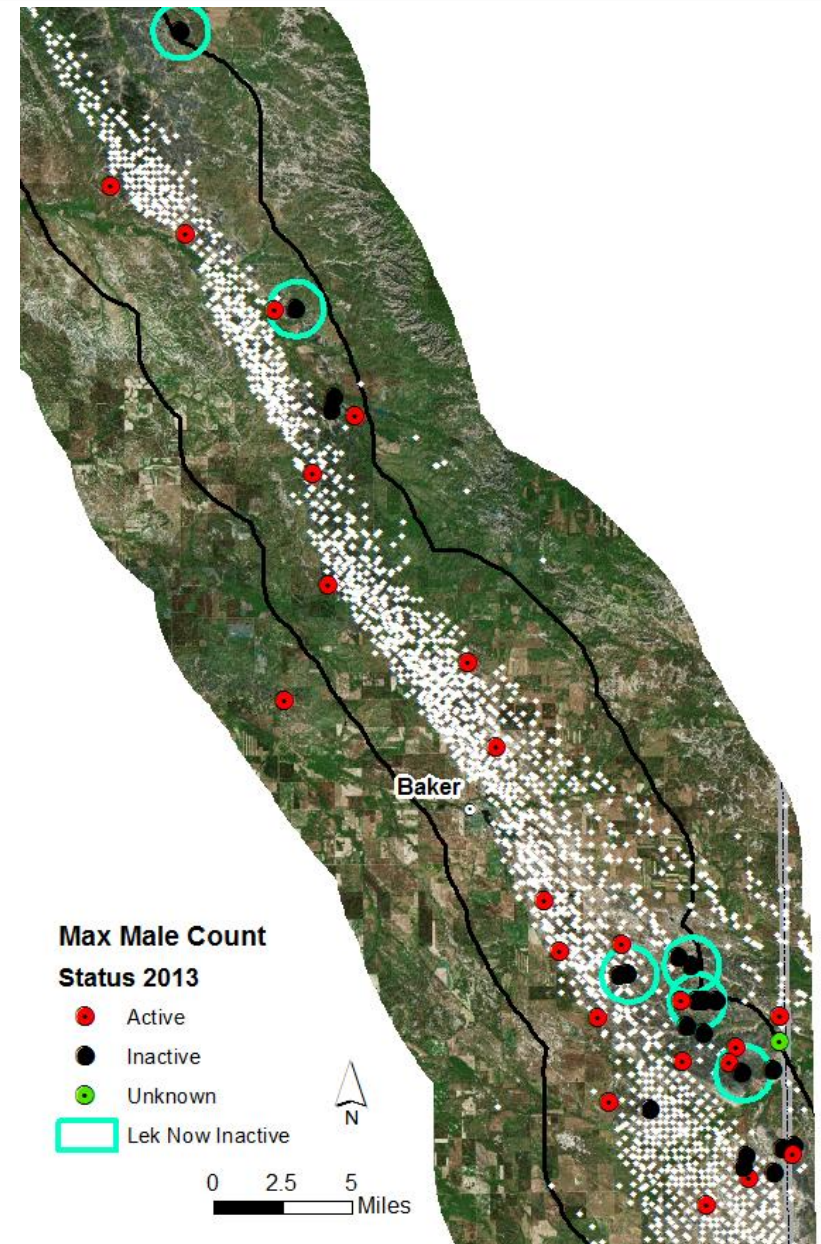




Lek Persistence: Spatial Patterns

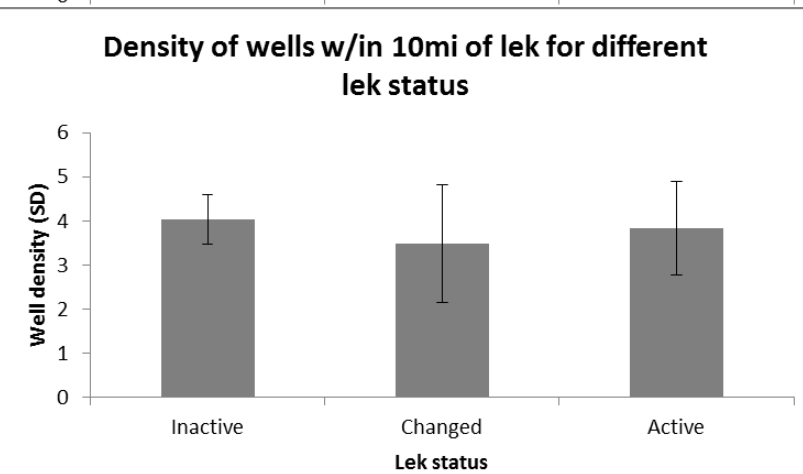
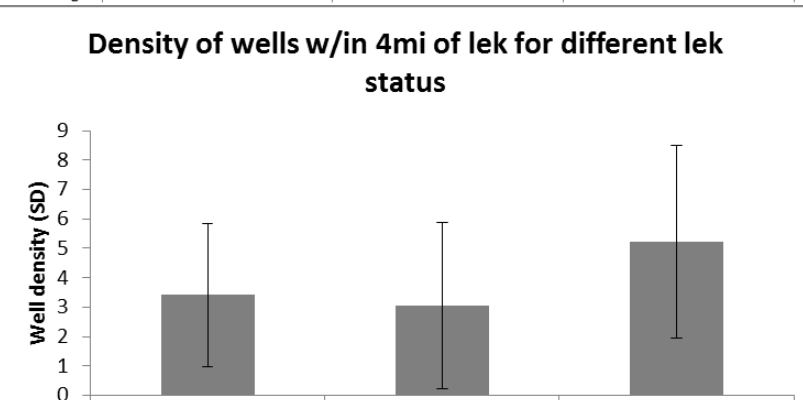
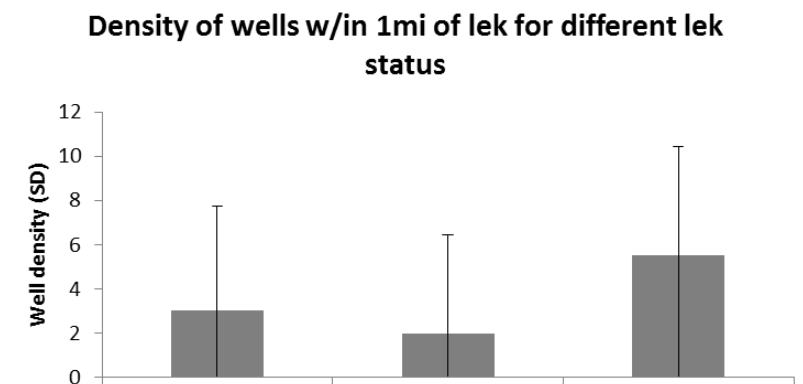
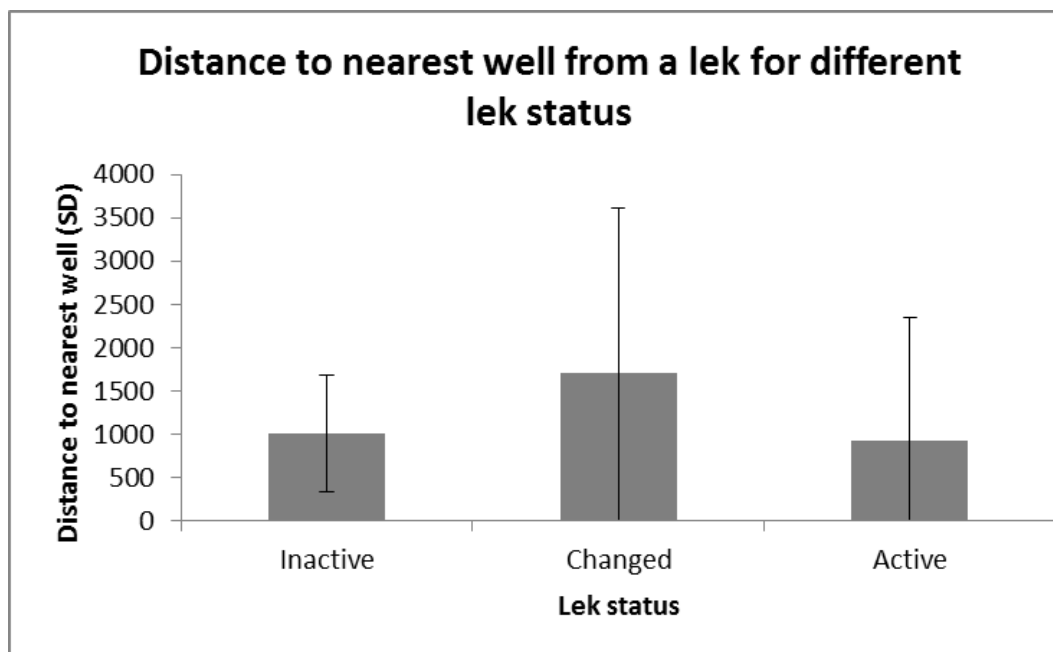
Lek Status Change Categories	2007-2013
# leks active ≥ 1 yr between 2007-2013	28*
leks remaining active in 2013	22 (78.6%)
previously active leks inactive in 2013	6 (21%)

* Includes 15 leks found by HWA or others since 2007



Trends: Lek Status Relative to Oil/Gas Wells

- Comparison of lek status 2007-2013 relative to proximity to and density of oil/gas wells
- Considered well data from 2006 (displayed below) and 2013
- Used scales of 1, 4, and 10 sq. miles for well density
 - **No apparent difference among status categories relative to oil/gas features**
 - **If anything, results are opposite of conventional expectations**

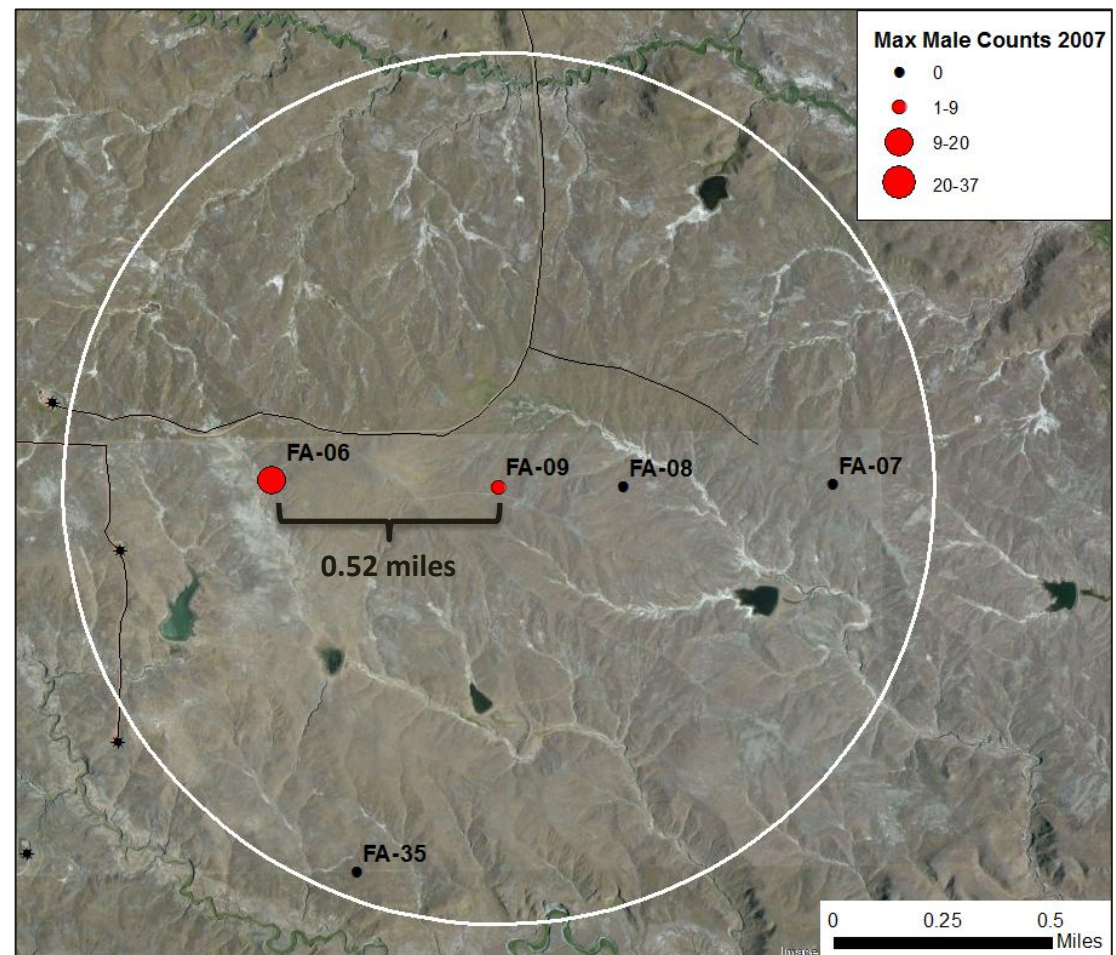


- Not always as clear-cut as it seems
- Of the six previously active leks that are now inactive:
 - 2 are believed to be satellite leks
 - 1 was a very small “new” lek that we believe moved to a different location nearby
 - 2 declined for no obvious reason; one is completely outside the oil/gas development and one is on the edge of low density development
 - 1 was clearly disturbed by a wind farm

Example #1: Lek Status Active→Inactive

Lek ID	2007	2008	2009	2010	2011	2012	2013
FA-09	2	0	0	0	0	0	0

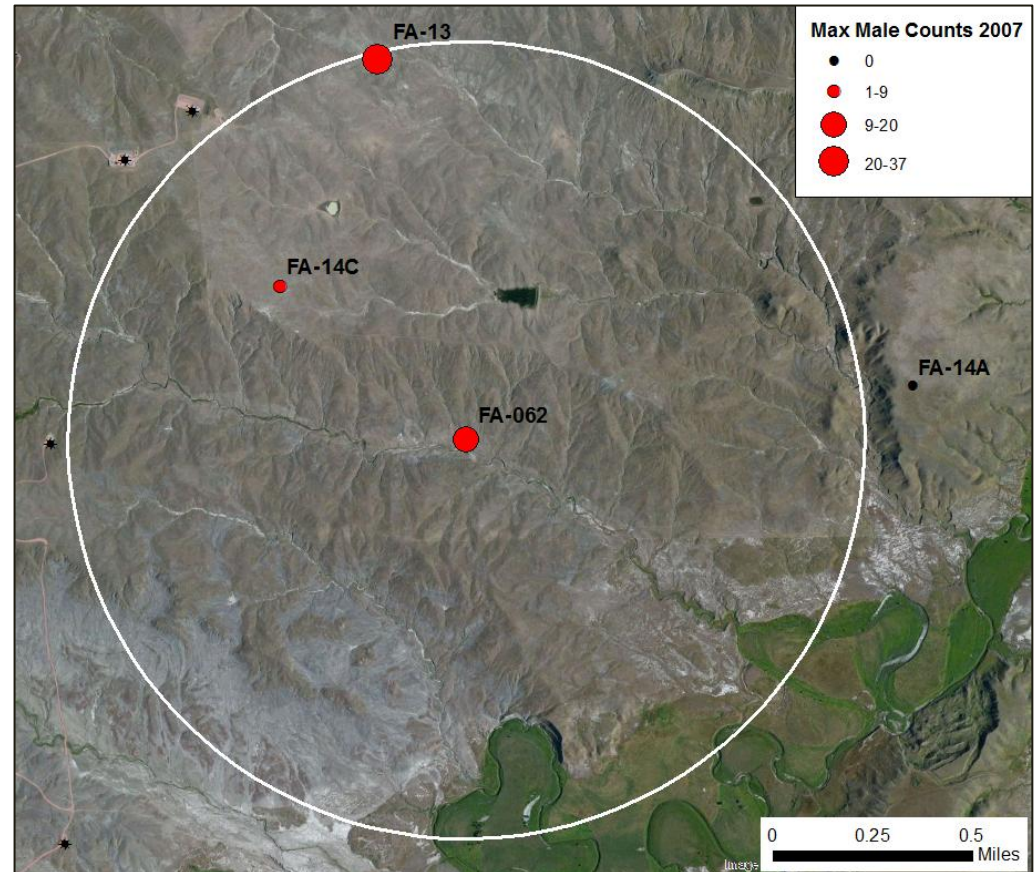
- FA-09
 - MTFWP lek location
 - 2 males on last survey in 2007 only
 - 0.52 miles from established lek
 - One oil/gas well within 1 mile
 - Suspected satellite lek location



Example #2: Lek Status Active→Inactive

Lek ID	2007	2008	2009	2010	2011	2012	2013
FA-062	18	1	0	0	0	0	0

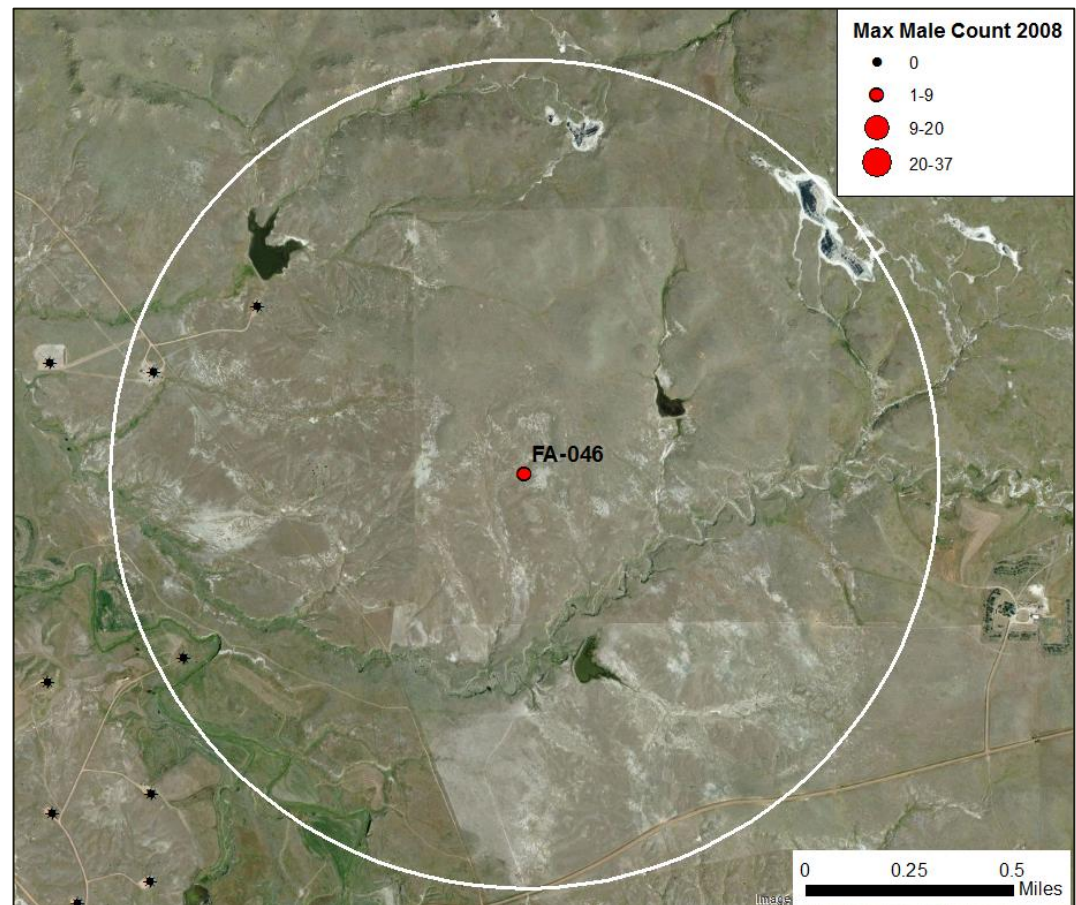
- FA-062
 - BLM “unknown” lek location
 - Confirmed in 2007
 - Males observed flying from FA-13 in direction of FA-062
 - 0 oil/gas wells within 1 mile
 - Suspect lek is part of three-lek complex rather than independent



Example #3: Lek Status Active→Inactive

Lek ID	2007	2008	2009	2010	2011	2012	2013
FA-046	--	3	0	0	0	0	0

- FA-046
 - Reported by other surveyor in 2007
 - Confirmed active with multiple observations of >2 males in 2008, but inactive since 2008.
 - Three oil/gas wells within 1 mile
 - Arguably should not have been listed as confirmed unless active another year



- 1) Using 2007 as a baseline, the population declined ~40% following the outbreak of WNV during the summer of 2007 and has yet to recover to previous levels
- 2) No obvious relationship detected between declines in male abundance or lek persistence in relation to oil/gas wells during the past seven years
- 3) To the contrary, active leks tended to be in areas with higher well densities than inactive leks, which is likely a function of extensive overlap between the distribution of sagebrush habitat and the oil/gas resources
- 4) Trends and patterns from the past 7 years may not be reflective of the years prior to 2007 nor do we know if 2007 is an appropriate baseline.

- 5) Even as many leks have declined since 2007, most have persisted even in close proximity to oil/gas wells
- 6) Disturbance did not appear to be a factor in at least 4 of 6 cases of previously-active leks becoming inactive
- 7) Clearly more comprehensive statistical analyses are needed, in which multiple natural and anthropogenic features are considered, for identifying the most important factors influencing male lek attendance and persistence

Acknowledgments

Funding:

Denbury and Fidelity Exploration & Production

Data Sharing and Support:

MTFWP, BLM and NDGFD



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Acknowledgments



Example #4: Lek Status Active→Inactive

Lek ID	2007	2008	2009	2010	2011	2012	2013
FA-053	10	6	0	0	0	0	0

- FA-053
 - Found in spring 2007
 - Believe this was the new location for FA-Unk12
 - Many oil/gas wells and within 1 mile of landfill
 - Wind farm constructed summer 2007
 - Turbine unknowingly sited on lek location
 - Inactive 2-years post-construction of windfarm

